II. Background

Since 1942, the U.S. government and contractors have conducted various research and development activities at the Oak Ridge Reservation (ORR), located in Anderson and Roane Counties in Tennessee. These activities were primarily conducted at four separate facilities previously known as the Y-12 plant, the K-25 site, the S-50 site, and the X-10 site. For much of ORR's history, the research and development activities focused on designing and producing materials and components for nuclear weapons. In recent years, however, the ORR facilities' missions have changed considerably. While some ORR facilities continue to conduct nuclear research and production projects vital to national security, other ORR facilities devote considerable resources to environmental research and restoration.

The U.S. Department of Energy's (DOE's) environmental restoration activities address contamination that remains from past research, development, and production operations. A challenge faced by DOE has been how to handle "mixed wastes," or wastes that contain both chemical and radioactive contamination.

What is "mixed low-level radioactive and hazardous waste?" Waste management regulations define what materials should be considered "hazardous waste" and what materials should be considered "radioactive waste." Some wastes, however, meet the criteria set forth in both definitions. Such materials are considered "mixed low-level radioactive and hazardous waste," which is commonly referred to as mixed LLW. Depending on the source of the waste, mixed LLW can be liquid or solid. The TSCA Incinerator treats mixed LLW.

One way DOE and its contractors have addressed the challenge of mixed LLW is to design and operate an incinerator that treats and reduces the volume of waste materials. The incinerator is located at East Tennessee Technology Park (ETTP), formerly the K-25 site (see Figure 2). The incinerator is commonly known as the "TSCA Incinerator" because this operation is authorized under the Toxic Substances Control Act (TSCA) to treat wastes containing polychlorinated biphenyls (PCBs). The incinerator is also permitted under the Resource Conservation and Recovery Act (RCRA) to treat hazardous wastes. Construction of the incinerator was completed in 1989, and the incinerator began routinely treating wastes from ORR and other DOE facilities in 1991. The TSCA Incinerator continues to operate today.

This public health assessment (PHA) evaluates the public health implications of environmental releases from the TSCA Incinerator, including air emissions, solid wastes, and discharges to surface water. This PHA focuses almost entirely on *environmental* health concerns; that is, whether local residents living in communities near ETTP have contacted contamination at levels that might cause health problems. ATSDR is aware that some residents also have concerns about past and ongoing *occupational* exposures to contaminants at ORR. However, ATSDR's mandate does not include evaluating most occupational exposure scenarios. Those who are interested in learning more about occupational health issues for this site should refer to resources listed in Section V of this PHA.

This PHA presents the most extensive environmental health review to date of the TSCA Incinerator. ATSDR gathered and critically reviewed data and reports published by many parties, including environmental and health agencies, a local citizens' oversight committee, DOE and its contractors, and a group of independent experts chartered by the Governor of Tennessee. The PHA examines emissions monitoring data, environmental sampling data, and other observations that were collected over the entire history of the TSCA Incinerator's operations.

ATSDR's approach to evaluating the TSCA Incinerator started with collecting background information on topics such as operational history, community health concerns, environmental setting, and demographics. This section summarizes background information by presenting facts and observations about the TSCA Incinerator without any analyses or interpretations. Later sections in this report (Sections III through VII) describe how the background information fits into the overall environmental health analysis.

II.A. Site and Process Description

As Figure 2 shows, the TSCA Incinerator is located in the northeast corner of ETTP, which was formerly known as both the K-25 site and the Oak Ridge Gaseous Diffusion Plant. ETTP spans approximately 700 acres to which the public has no access, unless accompanied by an escort from the facility (see Section II.D). DOE constructed the TSCA Incinerator to help manage a growing volume of mixed LLW generated from various processes at ORR and at other DOE facilities. The purpose of the incinerator is to reduce the amount of waste that requires management, both by destroying hazardous organic chemicals in wastes and by reducing the volume of wastes containing radionuclides. The remainder of this section provides background information on incineration technology (see Section II.A.1) and describes the unit operations in the TSCA Incinerator (see Section II.A.2).

II.A.1. General Information on Incineration

Incinerators burn waste, thereby destroying some waste materials and reducing the volume of others. Although many different incineration technologies exist, nearly all incineration facilities share some common input and output streams, as Figure 3 depicts. The primary inputs at most incineration facilities are the wastes to be treated, along with air and additional fuel to support combustion. Incineration occurs within combustion chambers, which destroys most organic material in waste, but in the process generates two general types of output streams:

- **Air emissions.** All incinerators have air emissions. Stack air emissions are gaseous, vapor, and particle-bound by-products of combustion. More information on these emissions is presented later in the section. Facilities also have fugitive air emissions, which are releases to the air from process points other than stacks (e.g., equipment leaks, wind-blown dust). The design of an incinerator, including waste and residual handling, largely determines the amount of fugitive air emissions that might occur. Refer to Section III.B for more information on the specific contaminants released from the TSCA Incinerator, both in fugitive and in stack emissions.

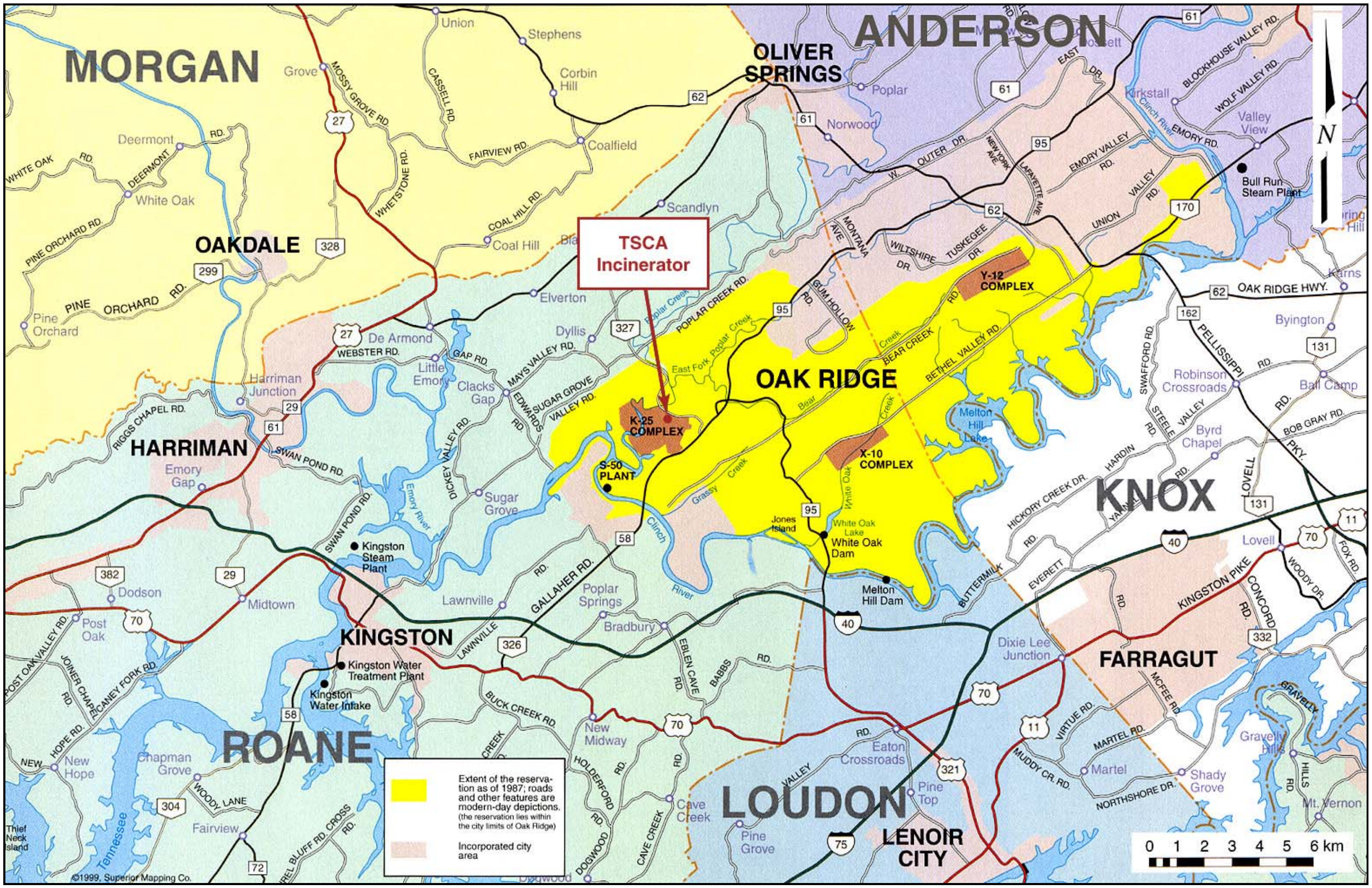
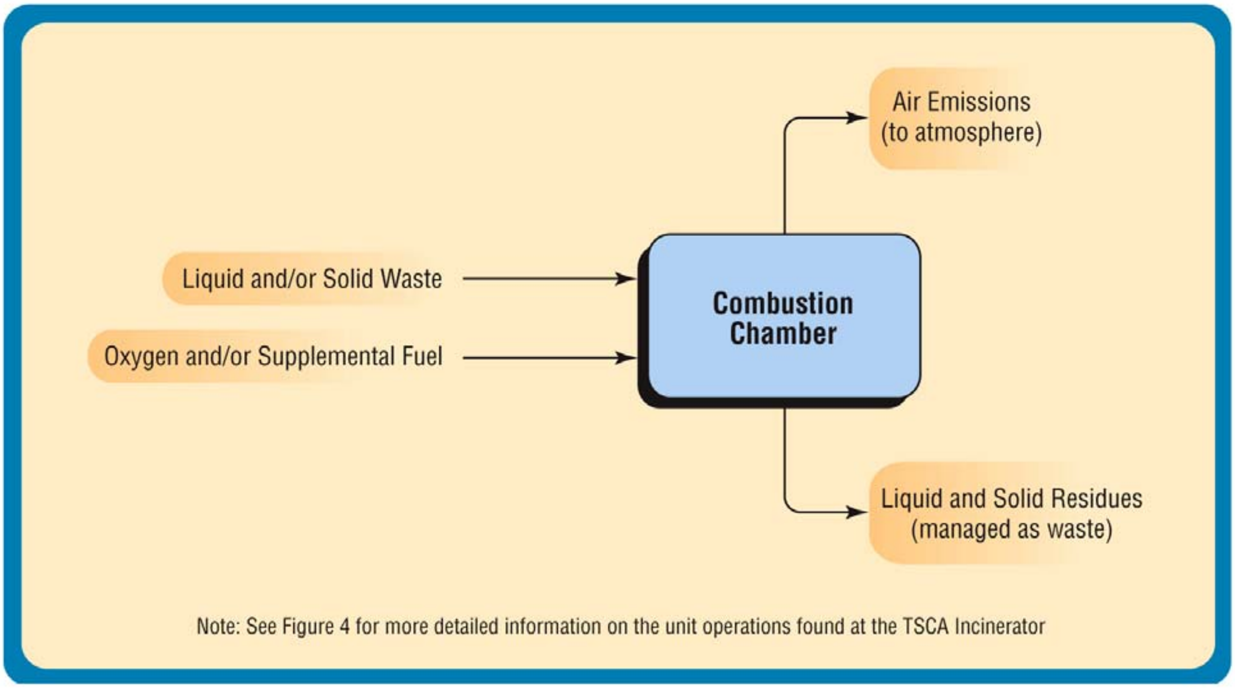


Figure 2. Location of the TSCA Incinerator

Figure 3. Generic Process Streams at Most Incineration Facilities



- **Residuals.** Incineration facilities also generate solid and liquid residuals. These typically include wastewater from air pollution control devices and solid wastes, such as ash that remains in the combustion chamber and sludge that settles from wastewater treatment operations. Residuals are handled according to applicable waste management regulations. Section V of this PHA presents ATSDR's evaluation of the residuals generated at the TSCA Incinerator.

Those interested in more detailed information on incineration are referred to various documents published by government agencies on environmental health concerns related to thermal treatment technologies (e.g., ATSDR 2002; EPA 1998; NRC 2000).

ATSDR is aware that many parties continue to debate whether incineration is a viable method of waste management. This PHA is not designed to enter this debate. Rather, its purpose is to evaluate the environmental health concerns specific to the TSCA Incinerator at ETTP. It is worth noting, however, that ATSDR has already conducted an extensive public health review of incineration and thermal treatment technologies (ATSDR 2002). That review found that the design and operation of an incinerator (see text box) must be considered when evaluating a particular site. Accordingly, this PHA not only reviews environmental sampling data collected near ETTP, but also considers specific information on how DOE designed and operates the TSCA Incinerator.

"Thermal treatment technologies [including incinerators] are inherently neither safe nor unsafe; whether they are safe depends on how they are designed and operated" (ATSDR 2002).

II.A.2. Process Description of the TSCA Incinerator

This section describes key elements of the engineering processes at the TSCA Incinerator, focusing on how the engineering design relates to potential air emissions and how waste material passes through the facility. This section provides an overview of the incinerator design, without necessarily identifying and commenting on the countless individual components (e.g., buildings, trailers, tanks, piping, connections) installed at the incinerator. Readers interested in a more detailed account of the engineering design should refer to DOE's permit application for the TSCA Incinerator, which includes highly detailed information about the incinerator design and operation (Radian 1997).

All equipment at the TSCA Incinerator can be classified into five general categories, as shown in Figure 4, on the following page. The following paragraphs describe the role each category of equipment plays and identify the main air emissions sources from the facility:

- **Waste handling (see box 1 in Figure 4).** The TSCA Incinerator treats solid wastes, liquid wastes, and mixtures of the two. These wastes must be thoroughly characterized before arriving at the TSCA Incinerator, and the facility's environmental permits greatly restrict the types and amounts of waste that the incinerator can treat. EPA and TDEC set these restrictions, commonly referred to as "Waste Acceptance Criteria," based on specific tests demonstrating how effectively the TSCA Incinerator destroys wastes. Refer to Section II.C of this PHA for more detailed information on the Waste Acceptance Criteria.

  The composition of the wastes treated at the TSCA Incinerator can vary considerably throughout the year. Composition data comes largely from analytical data for the incoming wastes. For every year the TSCA Incinerator has operated, DOE has reported "rolling totals" that document the total amount of various chemical and radiological constituents in the waste (DOE 2003a). ATSDR thoroughly reviewed these records when preparing this PHA. As an example of the constituents, the 2003 "rolling totals" data include waste throughput estimates for approximately 200 organic chemicals, more than 25 metals, and more than 25 radionuclides. It should be noted that many of the constituents were tested for in the incoming waste, but never detected.

  Solid wastes arrive at the TSCA Incinerator in enclosed containers, such that dusts or particles cannot blow from the waste material into the environment. Solid waste materials are repackaged into combustible containers, which are kept in storage areas before they are fed to the incinerator. The repackaging occurs over a ventilated table, further reducing the possibility of untreated wastes becoming airborne; exhaust air from repackaging areas passes through filters before being vented to the atmosphere. Examples of the types of solid wastes processed at the TSCA Incinerator include pallets, spent carbon, used wash rags, filters, trash, and spent personal protective equipment.

  Liquid wastes are stored at the TSCA Incinerator primarily in tanks. While these tanks do have passive vents to the atmosphere, all vapors released from tanks first pass through carbon adsorption filters that capture volatile chemicals which might otherwise enter the air. The liquid wastes are piped directly into the incinerator, either to the rotary kiln or to the afterburner (see below for more information on these operations). With this design,

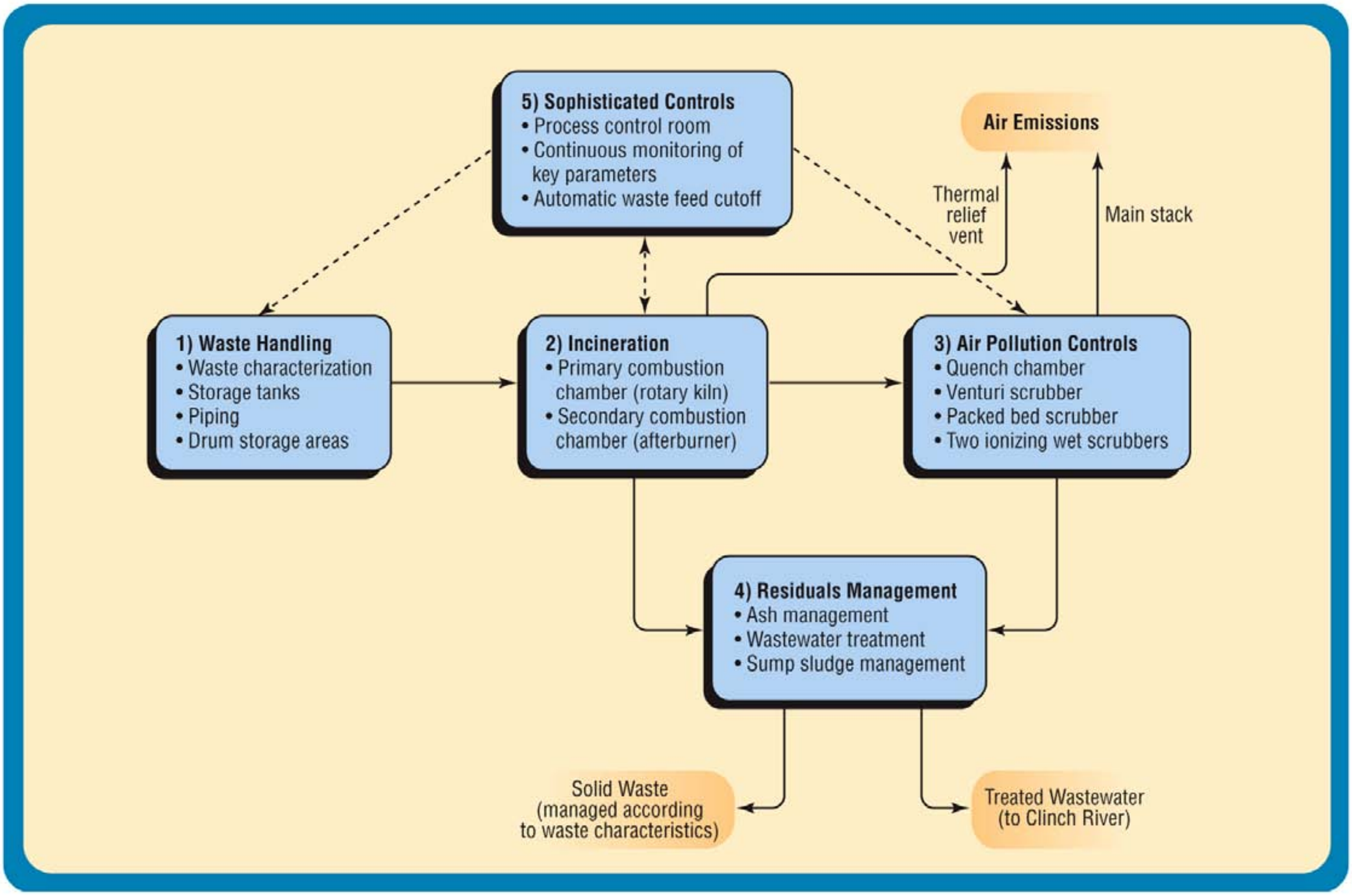


Figure 4. Block Diagram of the TSCA Incinerator

evaporative losses and other fugitive emissions of untreated liquid wastes are expected to be minimal. The TSCA Incinerator is permitted to treat both aqueous waste (e.g., wastewater) and organic waste (e.g., oils, solvent mixtures, degreaser fluids).

- **Incineration (see box 2 in Figure 4).** The TSCA Incinerator has two combustion chambers in which wastes are burned. The fuel for combustion comes from organic material in the waste itself and from supplemental fuel sources. Natural gas is the primary supplemental fuel used at the TSCA Incinerator, but fuel oil can also be used. Oxygen in air is drawn through the incinerator to support combustion. Further details on the two combustion chambers follow.

  First, all solid waste (along with some liquid waste) is fed into the primary combustion chamber, which is a rotary kiln. The kiln is cylindrical in shape, 6 feet in diameter, and 25 feet long. The inside temperature varies with the type of waste treated, but is generally at least 1,580 degrees Fahrenheit. Incineration of waste in the kiln generates gases which pass into the secondary combustion chamber (see next paragraph) for further treatment. Incombustible material in the waste leaves the rotary kiln in the form of ash. At the end of the kiln, the ash drops into a water pool and enters the residuals management part of the process, as described further below.

The secondary combustion chamber at the TSCA Incinerator is an afterburner, which serves two general purposes. First, some liquid waste is sprayed directly into the afterburner for purposes of treatment. Second, the afterburner destroys organic material in the gases generated in the rotary kiln. The temperature in the afterburner is typically at least 2,205 degrees Fahrenheit, and gases are exposed to this temperature for at least 4 seconds. With one exception, the treated air stream from the afterburner always passes directly into air pollution controls (see below). As the exception, a thermal relief vent (TRV) on the afterburner opens on infrequent occasions to avoid dangerous buildup of gases and to prevent situations that might harm the downstream air pollution controls. When the TRV opens, the waste feed to the incinerator is instantly cut off, and gases in the afterburner bypass air pollution controls and vent directly to the atmosphere. In the first 14 years that the TSCA Incinerator operated (1991 to 2004), the TRV opened 18 times. Sections III.B.2 and III.D.2 comment further on the significance of the TRV openings.

The fate of waste constituents within the incinerator varies. For instance, organic chemicals are very efficiently destroyed in the incinerator (see Section II.C for quantitative information on the destruction efficiency). Incineration of organic chemicals primarily generates a mixture of low molecular weight by-products (e.g., water, oxygen, carbon dioxide) that are relatively harmless from a health perspective. However, some potentially harmful by-products do form, such as inorganic acids, dioxins, and furans. Metals and radionuclides in the waste feed are not destroyed in the combustion chambers. Thus, the effluent from the combustion chambers contain a mixture of vapors products and particles that pass through a series of air pollution controls (see below) before being vented to the atmosphere.

- **Air pollution controls (see box 3 in Figure 4).** The gases from the afterburner contain a mixture of chemicals (e.g., water, oxygen, carbon dioxide) that, from a health perspective, are relatively benign. But the gas stream also includes trace amounts of toxic contaminants (e.g., acids, dioxins, furans, metals, radionuclides) from the wastes or that were formed as combustion by-products. Consequently, environmental regulations require most incinerators to have air pollution controls to "clean" their effluents before they are vented to the atmosphere.

  The gases generated in the TSCA Incinerator's afterburner pass through multiple air pollution control devices designed to remove contaminants (primarily particle-bound contaminants and acidic gases) from the effluent stream. The sequence of air pollution controls — a quench chamber, a Venturi scrubber, a packed bed scrubber, and two ionizing wet scrubbers — efficiently removes numerous contaminants, including very fine particles, that would otherwise escape to the air. The contaminants that are removed (e.g.,

> As Figure 4 indicates, the main air emissions points from the TSCA Incinerator are (1) routine releases through the main process stack and (2) infrequent non-routine releases through the thermal relief vent. Section III of this PHA evaluates the public health implications of both types of releases.

metals, acids, radionuclides) are primarily captured in water that circulates through the air pollution controls. The next bullet item further discusses how the contaminants are handled in the wastewater streams. After passing through these multiple air pollution controls, the process gases are vented to the atmosphere through a 100-foot tall stack.

- **Residuals management (see box 4 in Figure 4).** The main process residuals from the TSCA Incinerator are ash from the rotary kiln, wastewater from the air pollution control devices, and sludge from a water sump. The wastewater and the sludge include the contaminants that the air pollution controls removed from the gases from the afterburner. DOE manages all three types of residuals according to applicable permits and waste management regulations.

  Specifically, the wet ash from the water pool at the end of the rotary kiln is transferred via conveyor belt to 55-gallon drums. (Keeping the ash wet minimizes the possibility of wind blowing contaminants into the atmosphere.) Ash samples from the drums are analyzed to determine whether the waste should be disposed of in a landfill or subjected to further treatment. When PCB-containing wastes are being burned, all ash found to contain more than 2 parts per million (ppm) PCBs must pass through the incinerator a second time for further treatment.

  The liquid residuals from the air pollution control devices are collected in a sump, which generates both solid waste (sludge) and liquid waste (wastewater). Radionuclides, metals, and other low-solubility substances removed by the air pollution controls will largely collect in the incinerator's sludge. DOE handles this sludge, similar to the ash, according to applicable solid waste management regulations. The wastewater, on the other hand, is either recycled to the air pollution control devices or pumped to the Central Neutralization Facility (CNF) — the main wastewater treatment plant at ETTP. The treated water is discharged to the Clinch River. DOE's National Pollutant Discharge Elimination System (NPDES) permit requires frequent sampling of the treated water to demonstrate that the effluent will not harm human health or the environment. Refer to Section V of this PHA for ATSDR's evaluation of the environmental health issues associated with the incinerator's residuals.

- **Sophisticated controls (see box 5 in Figure 4).** The TSCA Incinerator has sophisticated controls that help ensure the incinerator efficiently destroys wastes without causing air emissions possibly harmful to health and the environment. These automated controls monitor waste handling operations, incineration, and air pollution controls. Specifically, throughout the TSCA Incinerator process they initiate continuous readings of more than 30 different operating parameters. For instance, temperature in the combustion chambers, waste feed rates, and concentrations of selected gases in the stack exhaust are continuously measured whenever the incinerator operates. Further, the controls quickly shut down incineration operations whenever critical parameters are found to fall outside the TSCA Incinerator's environmental permits. (These shutdowns are more commonly known as automatic waste feed cutoffs, or AWFCOs.) In short, sophisticated automated controls help ensure that the TSCA Incinerator operates safely. Section II.C presents more information on this topic.

The previous discussion highlights general design features of the TSCA Incinerator that are most relevant to environmental releases and to ATSDR's evaluations presented in this PHA. Generally speaking, the incinerator is designed to ensure that organic material in the wastes is efficiently destroyed, with no hazardous residuals generated.

II.B. TSCA Incinerator Operational History

The TSCA Incinerator treats waste material consistently — but not continuously — throughout the year. DOE waste treatment records suggest that the incinerator typically operates up to 250 days per year. Downtime occurs due to various reasons, such as routine or non-routine maintenance.

ATSDR gathered three general types of information to characterize key features of the TSCA Incinerator's operational history:

- **Major permitting milestones (see Table 1).** Table 1 highlights milestones related to the permitting status of the TSCA Incinerator. While this table identifies many key events, it is not intended to be an exhaustive account of the incinerator's entire operational history.

Table 1. Selected Milestones in the TSCA Incinerator's Operational History

Date	Milestone
1984	Construction of TSCA Incinerator begun
May 1988	Final TSCA trial burn prior to permitting
June 1989	Final RCRA trial burn prior to permitting
June 1990	Final state emissions test prior to permitting
April 1991	***Start of routine waste treatment operations at the TSCA Incinerator***
June 1995	Updated state emissions test
November 2000	Updated state emissions test
May 2001	Updated RCRA/TSCA trial burn

Three important observations are evident from the table. First, unlike other emissions sources at ORR that ATSDR has evaluated to date, the TSCA Incinerator has only operated for the past 14 years. Therefore, as Section III explains, this PHA focuses only on potential exposures that have occurred since 1991. Second, the table indicates that DOE performed numerous emissions tests and trial burns before regulatory agencies would permit routine operations. This means that DOE had to characterize thoroughly the incinerator's performance before operations could commence. Third, the table notes that DOE performed several updates to its emissions tests and trial burns. Regulatory agencies required DOE to demonstrate, through these additional tests, that the incinerator continues to meet health-protective requirements specified in environmental permits. Taken together, these observations give some sense of the regulatory oversight of the incinerator's operations, an issue that Section II.C discusses further.

- **Amount of waste treated (see Figure 5).** Between April 1991 and December 2002, the TSCA Incinerator has treated approximately 16,000 tons of waste (DOE 2003a). Over the years, the waste constituents have varied; they typically include a mixture of volatile organic compounds, semi-volatile organic compounds (including PCBs), metals, inorganic compounds, and radionuclides. To illustrate waste-stream variability, the amount of PCBs treated per year has ranged from less than 1 ton to more than 50 tons.

  The amount of waste that the TSCA Incinerator treats is only a small fraction of the amount allowed under the facility's health-protective permits.

  Figure 5 shows how the annual amount of wastes treated at the TSCA Incinerator has varied from year to year. Waste treatment activity at the incinerator peaked in the mid-1990s and has decreased considerably since then. Not shown in Figure 5 is the fact that the TSCA Incinerator treats only a small fraction of the waste allowed in its environmental permits. Specifically, the current operating permits allow the TSCA Incinerator to treat no more than 1,836 pounds of liquid waste per hour and 964 pounds of solid waste per hour. Given these limits and assuming 10% downtime for routine maintenance, the TSCA Incinerator is currently permitted to treat approximately 10,000 tons of waste per year. Since 2000, however, the amount of waste treated at the TSCA Incinerator has been only 5% of the health-protective permitted limits.

  Thus, in recent years, the TSCA incinerator has clearly been operating at levels much lower than the overall capacity expressed in terms of total liquid waste feed per hour or total solid waste feed per hour. However, it should be noted that there are many permit conditions for specific contaminants and parameters in the feed that could potentially cause the allowable waste feed rate to be lower than the maximum limits based on liquid and solid mass throughput.

- **Thermal relief vent (TRV) openings (see Table 2).** As noted previously, the TRV on the TSCA Incinerator is a vent that opens to avoid situations where gases in the afterburner might harm or destroy the air pollution control devices. During the short time that the TRV is open, gases in the afterburner vent directly to the atmosphere without first passing through the air pollution controls — a situation that has raised concerns among some community members (see Section V). Accordingly, ATSDR obtained information on the history of TRV openings at the facility.

  As Table 2 shows, during the first 14 years of the TSCA Incinerator's operations, the TRV opened 18 times. The most frequent cause of the TRV openings was interruptions to the electrical power system. To minimize the likelihood of power losses shutting down operations, the incinerator is equipped with two separate feeders from the electric switchyard. But power outages have still caused 10 shutdowns (and TRV openings) over a 14-year period. The second most frequent cause was failures in the magnetic latch that keeps the TRV closed. After the last such failure (in July 1996), engineers at the facility designed and installed a new TRV closure mechanism that has addressed this problem (Iglar et al. 1998). The frequency of TRV openings has varied from year to year, with no TRV openings in some years and as many as five TRV openings in others.

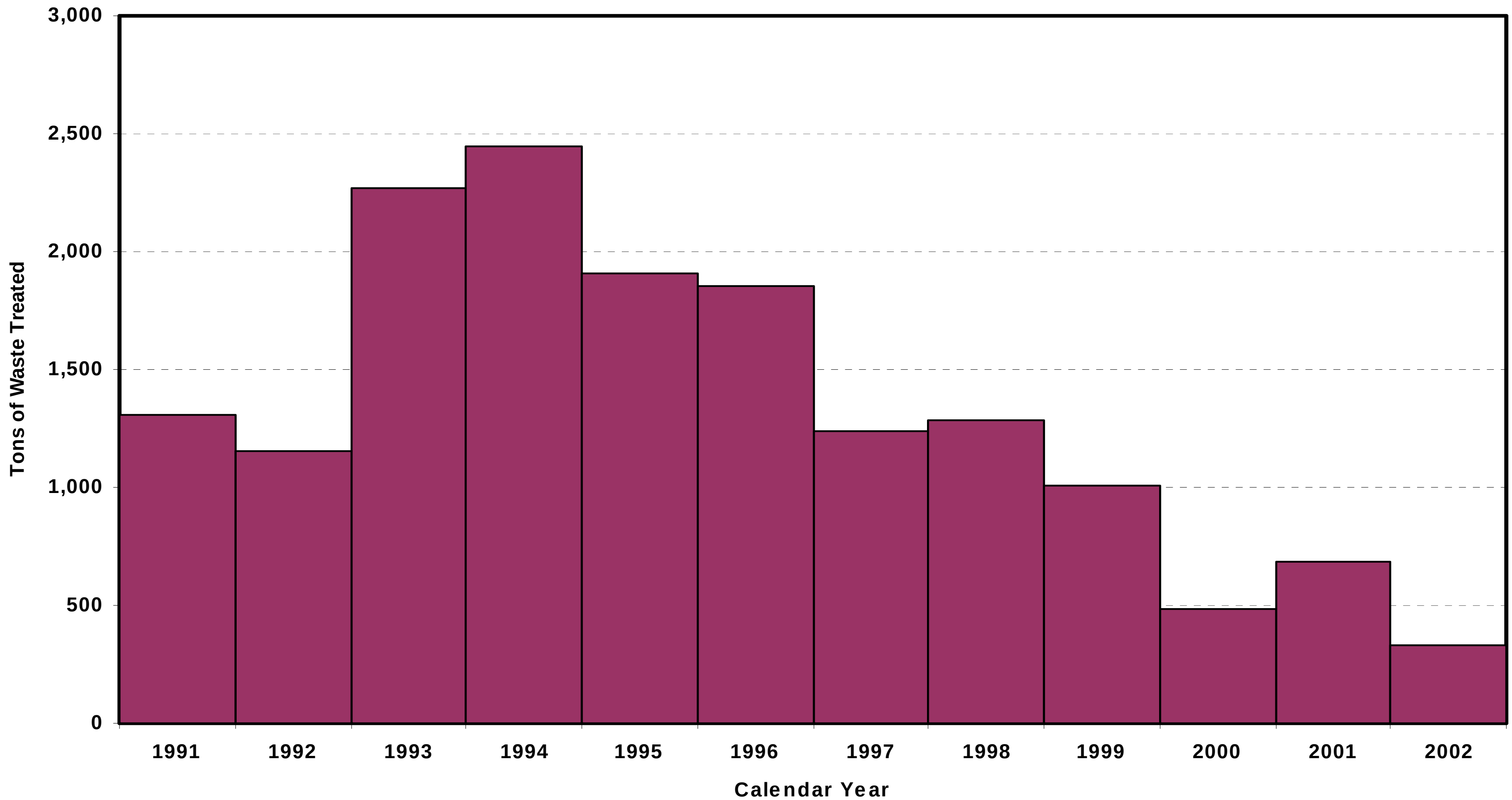


Figure 5. History of Waste Treatment Totals, by Calendar Year

Source of data: DOE 2003a.

Table 2. History of TRV Openings (1991–2004)

Date	***Cause***	***Ambient Air Sample Analyzed?***
December 20, 1991	Electrical power interruption	Yes
May 5, 1993	Electrical power interruption	Yes
May 6, 1993	False radiation criticality alarm	Yes
February 25, 1995	Electrical power interruption	Yes
May 31, 1995	Electrical power interruption	Yes
June 18, 1995	Electrical power interruption	Yes
December 9, 1995	Loss of TRV magnet	No
December 22, 1995	Loss of programmable logic controller	No
January 28, 1996	Loss of TRV magnet	Yes
January 31, 1996	Loss of TRV magnet	Yes
April 30, 1996	Loss of programmable logic controller	No
July 7, 1996	Loss of TRV magnet	Yes
July 12, 1999	Electrical power interruption	No
December 29, 1999	Loss of programmable logic controller	No
June 29, 2002	Electrical power interruption	No
July 22, 2002	Electrical power interruption	No
February 27, 2004	Electrical power interruption	No
May 13, 2004	Electrical power interruption	No

Source of data: DOE 2003b.

To ensure that air releases during TRV openings do not reach unsafe levels, immediately after gases are vented to the air DOE collects air samples at two off-site locations. If waste feed and operating conditions at the time of the TRV opening are not bracketed by those observed during previous events, the samples are analyzed. Table 2 notes that air samples were analyzed for nine out of the 18 TRV openings that occurred between 1991 and 2004. Section III.D of this PHA reviews the results of samples collected during these episodic releases.

The preceding discussion reviews key observations pertaining to the TSCA Incinerator's operational history. Still, as the next section of this PHA further describes, the facility's environmental permits largely dictate how DOE routinely operates the incinerator.

II.C. Remedial and Regulatory History

DOE could not begin waste treatment operations at the TSCA Incinerator until environmental regulatory agencies, primarily EPA and TDEC, issued the necessary permits. The permitting process for such a facility is quite extensive, as is demonstrated by the fact that more than 2 years passed between the time the TSCA Incinerator was constructed and when permitted operations began. Operations at the TSCA Incinerator must comply with multiple federal regulations (e.g., the Clean Water Act, the Clean Air Act, TSCA, and the Resource Conservation and Recovery Act, or RCRA) and supplemental regulations issued by the state of Tennessee. Further, many activities for operations involving radioactivity must meet standards established by DOE. Although the many permits governing the incinerator's operations address different issues, the environmental permits share one common feature: they are intended to prevent situations in which releases from the TSCA Incinerator can harm human health or the environment.

The remainder of this section reviews notable features of the environmental permits that pertain to environmental releases from the TSCA Incinerator:

- **Waste acceptance criteria.** DOE cannot burn simply any waste in the TSCA Incinerator. Rather, the facility's environmental permits have codes for specific wastes that the facility can treat. Further, the permits establish a Waste Analysis Plan that requires DOE to characterize all wastes sent to the TSCA Incinerator. Under this plan the waste generator must first characterize the chemical composition of waste, typically through rigorous laboratory sampling. The generator could be another department at ETTP, a different ORR facility, or possibly a different DOE facility. After reviewing the waste constituents, operators at the TSCA Incinerator decide whether further waste characterization is needed or whether the waste can be safely treated. Currently, DOE tracks the amounts of more than 250 different constituents in the wastes processed through the TSCA Incinerator (Radian 1997). Ultimately, these waste acceptance criteria help ensure — but do not guarantee — that DOE only accepts wastes the TSCA Incinerator can safely treat.

- **Operating parameters and automatic waste feed cutoffs.** In addition to an incinerator's design, the process operating parameters largely determine the waste destruction and removal efficiency. For instance, waste destruction efficiencies depend on many factors, including the combustion temperatures themselves, how long wastes remain in the combustion chambers, and how well wastes (particularly solid wastes) mix in them. Further, the efficiencies of waste destruction and removal are functions of the ash content in the waste and how the air pollution control devices are operated. The following text box defines the waste destruction and removal efficiency.

What is the waste destruction and removal efficiency (DRE)? The overwhelming majority of waste material fed to an incinerator is not released to the air. Rather, organic chemicals are destroyed in the combustion chambers; metals and radionuclides are largely removed from process streams by air pollution controls and eventually accumulate in solid residuals, whether the ash at the end of the rotary kiln or the sludge from the water used in the air pollution controls.

The destruction and removal efficiency refers to the percent of waste material that is either destroyed or otherwise removed from the waste feed. For most hazardous waste incinerators, DREs for organic compounds are greater than 99.99% and well over 90% for many metals and radionuclides. The DRE for a given chemical is calculated using the following equation:

$$\text{DRE} = (\text{Feed Rate} - \text{Emission Rate}) / (\text{Feed Rate})$$

The feed rate is the measured amount of chemical in the wastes fed to the incinerator and the emission rate is the measured amount of chemical in the stack exhaust.

Recognizing that operating parameters are closely linked to incinerator performance, environmental regulatory agencies require thermal treatment facilities to determine, typically through trial burns, the ranges of operating parameters needed to achieve the required destruction removal efficiencies (DREs). For the TSCA Incinerator, DOE had to demonstrate that the incineration process could achieve DREs greater than 99.9999% for PCBs and greater than 99.99% for other organic chemicals expected to be found in hazardous waste. To date, DOE has conducted multiple trial burns at the TSCA Incinerator, all of which have challenged the incinerator to destroy wastes under unfavorable conditions, such as lower combustion temperatures and higher feed rates.

The trial burns conducted at the TSCA Incinerator served two critical purposes. First, they proved that the incinerator could meet the numerous and extensive requirements set forth in environmental regulations, such as minimum DREs and maximum emission rates for certain pollutants. (Appendix A presents detailed summaries of the trial burns conducted at the TSCA Incinerator.) Second, they provided information that regulators could use to establish limits on critical operating parameters. Table 3, for instance, lists several critical operating parameters that DOE must continuously monitor to ensure that the TSCA Incinerator operates in a manner consistent with conditions observed during the trial burns. Whenever operating parameters deviate from the limits shown in Table 3, an automatic waste feed cutoff occurs: the waste feed automatically shuts down, wastes remaining within the incinerator are fully treated, and no further waste is treated until the operating parameters return to acceptable values. Through this continuous monitoring and automatic waste feed cutoff process, regulators help ensure that the TSCA Incinerator only operates in a manner that has been shown to achieve the required waste-destruction efficiencies.

- **Inspections.** The TSCA Incinerator is inspected frequently. For example, TDEC officials typically conduct thorough inspections once a year, during which its representatives observe operations, review records, and interview staff. While inspectors have identified some minor violations of permit conditions, all such violations have been promptly addressed and corrected. Moreover, DOE's environmental permits require extensive self-inspections at regular intervals, ranging from daily to quarterly. These required self-inspections are intended to help DOE identify and promptly correct operational or equipment problems. Taken together, the DOE and TDEC oversight helps minimize the likelihood that critical operational problems at the TSCA Incinerator could go undetected.

Table 3. Limits Established in Permits for Selected Operating Parameters

Parameter	***Permit Limit***	***Rationale***	***Monitoring Status***
Outlet temperature of rotary kiln	> 1,580 ^{o}F	Lower temperatures could lead to more products of incomplete combustion and failure to meet required waste destruction efficiencies for organic wastes.	DOE must monitor all of the parameters listed in this table continuously. Outputs from the monitors are fed directly to the control room. Values found outside of permitted limits will trigger automatic waste feed cutoffs. DOE must frequently test and calibrate the sensors that measure the listed parameters.
Outlet temperature of afterburner	> 2,205 ^{o}F		
Gas residence time in the afterburner	> 2 seconds	The afterburner will not destroy organic compounds that move through the system too rapidly.	
Stack exit velocity	< 21.4 feet/second		
TRV opening	Must be closed	Operating with the TRV open would release exhaust gases to the air without first sending them through air pollution controls.	
Concentrations of carbon monoxide in the stack exhaust	<100 ppm (1-hour rolling average)	Higher carbon monoxide levels are an indicator of incomplete combustion or organic material.	
Solid waste feed rate to kiln	<1,008 lb/hour	The trial burns demonstrated that the incinerator can efficiently destroy wastes at these feed rates. Destruction efficiencies at higher feed rates have not been verified.	
Organic liquid waste feed rate to kiln	<812 lb/hour		
Aqueous liquid waste feed rate to kiln	<478 lb/hour		
Organic liquid waste feed rate to afterburner	<710 lb/hour		
Water recycle flow through venturi scrubber	<121 gallons/minute	Values outside these ranges would indicate that the air pollution controls might not be treating the exhaust streams efficiently.	
Effluent pH in the packed bed scrubber	<6.1 (with 30-minute delay)		

Notes:
Source of data: Radian 1997.
The temperature and residence time requirements only apply to TSCA conditions (i.e., incinerating wastes containing PCBs). The RCRA requirements for these parameters are less stringent.
The table lists only a subset of the operating parameters specified in the various environmental permits.

- **Other requirements.** The previous discussion reviews some important requirements set forth in the TSCA Incinerator's environmental permits. But this discussion is not exhaustive — the permits require numerous other actions, such as operator training, equipment testing and calibration, emergency planning, and extensive recordkeeping and reporting requirements. ATSDR carefully reviewed these aspects of the environmental permits and generally concurs with the regulatory agencies that the required controls are sufficient (e.g., frequency of equipment testing and calibration is adequate). Moreover, under a recent EPA regulation requiring hazardous waste combustion facilities to implement "maximum achievable control technologies" (MACT) in their processes, the incinerator is now subject to more stringent emissions limits. According to EPA, MACT represents the maximum degree of air emissions reductions that can be realistically achieved, when one considers the available emissions control technologies and their costs and benefits. The MACT standards came into effect on September 30, 2003.

Overall, the purpose of the previous discussion is to emphasize that the TSCA Incinerator is a closely regulated air emissions source. Due to the extensive environmental regulations and permitting requirements, DOE invested considerable effort to obtain its original permits and, to comply with those permits, closely monitors the incinerator's performance.

II.D. Environmental Setting

The environmental setting for a site largely determines how close residents can come to sources of contamination and how contaminants move through the environment. Accordingly, when evaluating environmental health issues for the TSCA Incinerator, ATSDR considered the following observations:

- **Land use.** As noted previously, ETTP is located on approximately 700 acres of land, which is primarily developed for industrial use. According to Figure 2, ETTP lies entirely within ORR, near the westernmost point of the DOE property. The ORR lands surrounding ETTP are largely undeveloped forest areas. Just beyond the ORR boundary near ETTP, some lands have been developed (mostly for light residential, commercial, and agricultural uses), but undeveloped areas are found throughout the Oak Ridge area. The farms in the area produce a variety of products, including beef, dairy, fruits, and vegetables. Home gardens are also present throughout the area. Hunting occurs at many off-site locations, and sometimes even occurs within the ORR boundary — but never within ETTP. Section II.F of this PHA presents detailed information on the residential populations nearest to the TSCA Incinerator.

- **Site access.** ETTP is completely surrounded by a chain-link fence topped with barbed wire. Signs reading "Danger — Unauthorized Personnel Keep Out" are posted at regular intervals along this fence. Only authorized employees and contractors are permitted to enter ETTP and the TSCA Incinerator area, and then only through guarded and gated entries. Visitors are allowed to enter ETTP, but only when accompanied by an escort. Security guard patrols and video surveillance cameras help prevent unauthorized entry to ETTP property. Given these extensive security measures and the extremely low likelihood of trespassers accessing the TSCA Incinerator site, this PHA does not address exposure scenarios for trespassers (see Section III.A). In a response to a community health concern (see Section V), ATSDR does provide insights on exposure scenarios for authorized visitors to the TSCA Incinerator.

- **Terrain.** The TSCA Incinerator is located in a small valley between two ridges (Black Oak Ridge and Pine Ridge) which, like most of the mountain ridges in this area, run from southwest to northeast. Both ridges reach elevations of more than 1,000 feet above sea level, which is approximately 200 feet higher than the base elevation of the TSCA Incinerator. These terrain features are notable because they strongly influence the prevailing wind patterns, which largely determine where any contaminants from the TSCA Incinerator might disperse. As evidence of this, some reports have noted that the prevailing winds generally follow the orientation of the southwest-to-northeast terrain features in the area: daytime prevailing winds tend to be "up-valley" from the southwest, while nighttime prevailing winds tend to be in the opposite direction (Iglar et al. 1998).

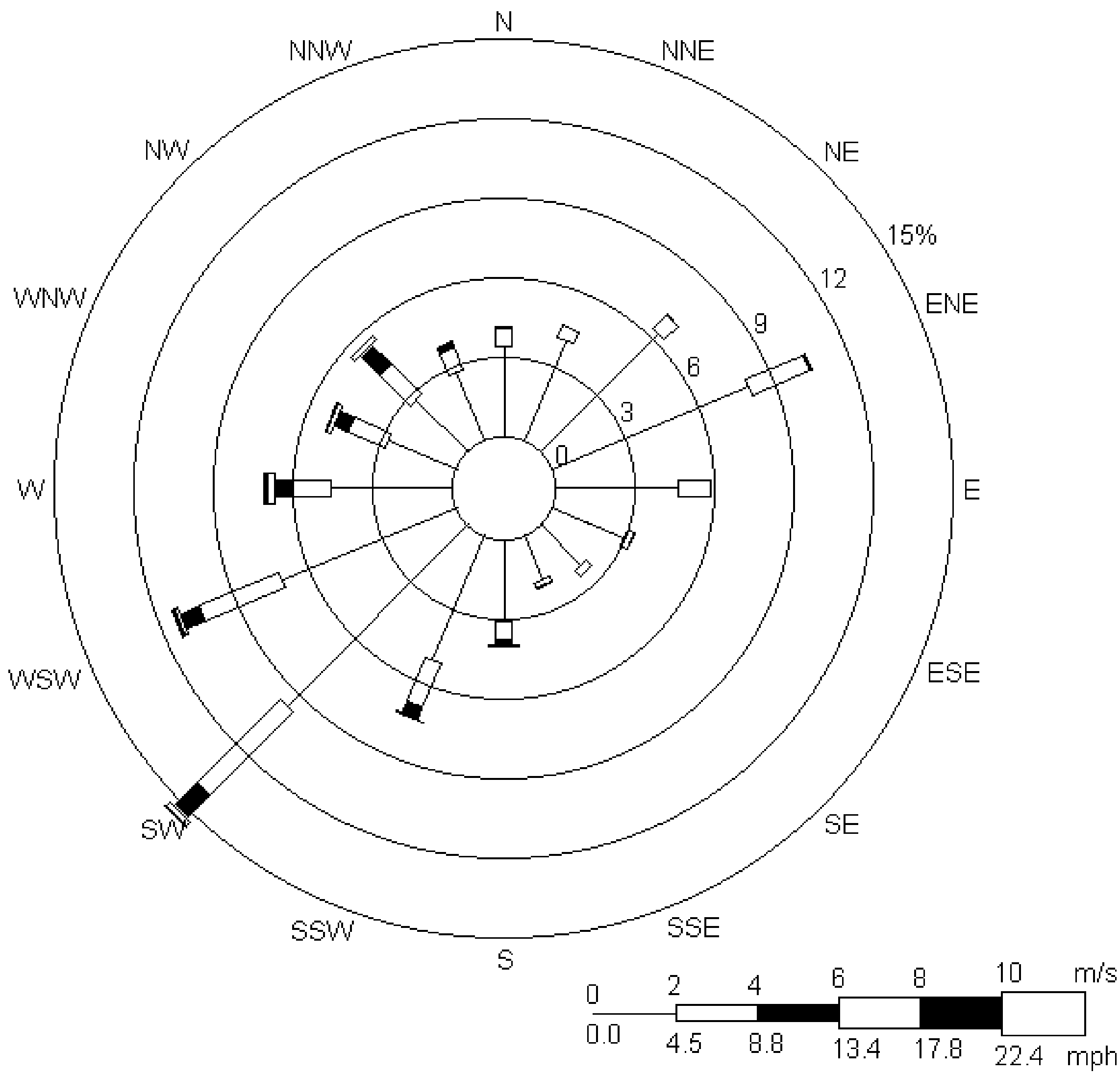
- **Climate and prevailing wind patterns.** The Oak Ridge area has a moderate climate. According to 30 years of data compiled by the National Climatic Data Center, the average annual temperature at Oak Ridge is 68.9 degrees Fahrenheit, with strong seasonal variations. Each year, the area receives approximately 55 inches of precipitation, mostly in the form of rain.

  The prevailing wind patterns in the Oak Ridge area tend to be along the valley floor directions. To illustrate this, Figure 6 summarizes hourly wind speed and wind direction measurements in a format known as a wind rose. The wind rose displays the statistical distribution of wind speeds and wind directions recently observed at a meteorological station located at ETTP. As Figure 6 depicts, the prevailing wind patterns near the TSCA Incinerator are from the general southwest direction (i.e., west-southwest, southwest, south-southwest) toward the northeast and, to a lesser extent, from the general northeast direction toward the southwest. These directions correspond to up-valley and down-valley flows — directions consistent with local terrain features. Despite the dominance of winds along the valley axis, Figure 6 indicates that winds occasionally blow in other directions. As Section III.D further discusses, when reviewing the ambient air monitoring data and ambient air sampling data for this site, ATSDR focused on exposures that might occur to residents located in the prevailing wind directions, with the understanding that residents who do not live in the prevailing wind directions would experience lower exposures.

- **Surface water.** Precipitation runoff near the TSCA Incinerator either enters storm drains or drains directly into Mitchell Branch, a small stream at ETTP that flows into Poplar Creek. Additionally, wastewater from the TSCA Incinerator, after being treated at the CNF, discharges through a permitted outfall at ETTP into the Clinch River. Therefore, when evaluating potential exposures to water contaminants associated with the TSCA Incinerator, this PHA considers only those exposures that might occur in the Clinch River, at locations downstream from its confluence with Poplar Creek. ATSDR addresses this issue as a community concern in Section V of this PHA.

The previous discussion is intended to identify aspects of the environmental setting that are most relevant to releases from the TSCA Incinerator. Those interested in further information on the environmental setting are referred to other resources (e.g., DOE 1991–2002).

Figure 6. Typical Wind Rose for the ETTP Area



Notes:
This wind rose was generated from meteorological data collected in 1999 at a weather station at ETTP. Wind measurements were made at 10 meters above ground surface. Wind roses for other years display nearly identical prevailing wind patterns.
Bars in the figure indicate the direction *from which* wind was blowing. The shading and thickness of the bars indicate the wind speeds observed for each wind direction. Specifically, the circular grid lines represent the percent of time that the wind blows in a particular direction, and the wind direction for a given bar is from the end of the bar towards the center of the wind rose.

II.E. Local Emissions Sources and Regional Air Quality

Although this PHA focuses on environmental health concerns specific to the TSCA Incinerator, ATSDR identified some general air quality issues for the Knoxville metropolitan area that need to be reviewed to better appreciate the significance of the incinerator's releases. The remainder of this section provides perspective on these related issues, which include other air emissions sources near ETTP (Section II.E.1) and regional air quality concerns (Section II.E.2).

II.E.1. Other Air Emissions Sources

When evaluating the air exposure pathway, ATSDR typically considers not only emissions from the source of concern (in this case, the TSCA Incinerator) but also emissions from other sources in the area. ATSDR takes this approach because community members ultimately are exposed to air contaminants released from all local sources, not just contaminants released from a single source. Accordingly, this section presents information ATSDR gathered on two types of emissions sources near ETTP.

- **Industrial emissions sources.** For insights on industrial emissions sources near ETTP, ATSDR first accessed data from EPA's Toxics Release Inventory (TRI). The TRI reporting regulations require many industrial and federal facilities to disclose annually the amounts of toxic chemicals that they release to the environment and manage as waste. While these regulations do not apply to all facilities or to all possible contaminants (such as radionuclides), the TRI data provide an extensive account of air emissions from industrial sources.

  According to the most recent data available to ATSDR when preparing this PHA, for calendar year 2001 six industrial facilities located within 10 miles of the TSCA Incinerator submitted air emissions data to TRI. Table 4 summarizes the air emissions data that the facilities reported, and Figure 7 shows the locations of these facilities. Two observations can be made from the table: first, the TSCA Incinerator is somewhat isolated from large industrial air emissions sources, as the closest facility that disclosed any air emissions to TRI is 4 miles from ETTP. Second, the TSCA Incinerator accounts for an extremely small fraction (<0.02%) of the total toxic chemicals reported to TRI by other industrial facilities located within 10 miles. Readers should refer to Section V.B of this PHA for further insight on the inferences that should be drawn from the TRI data.

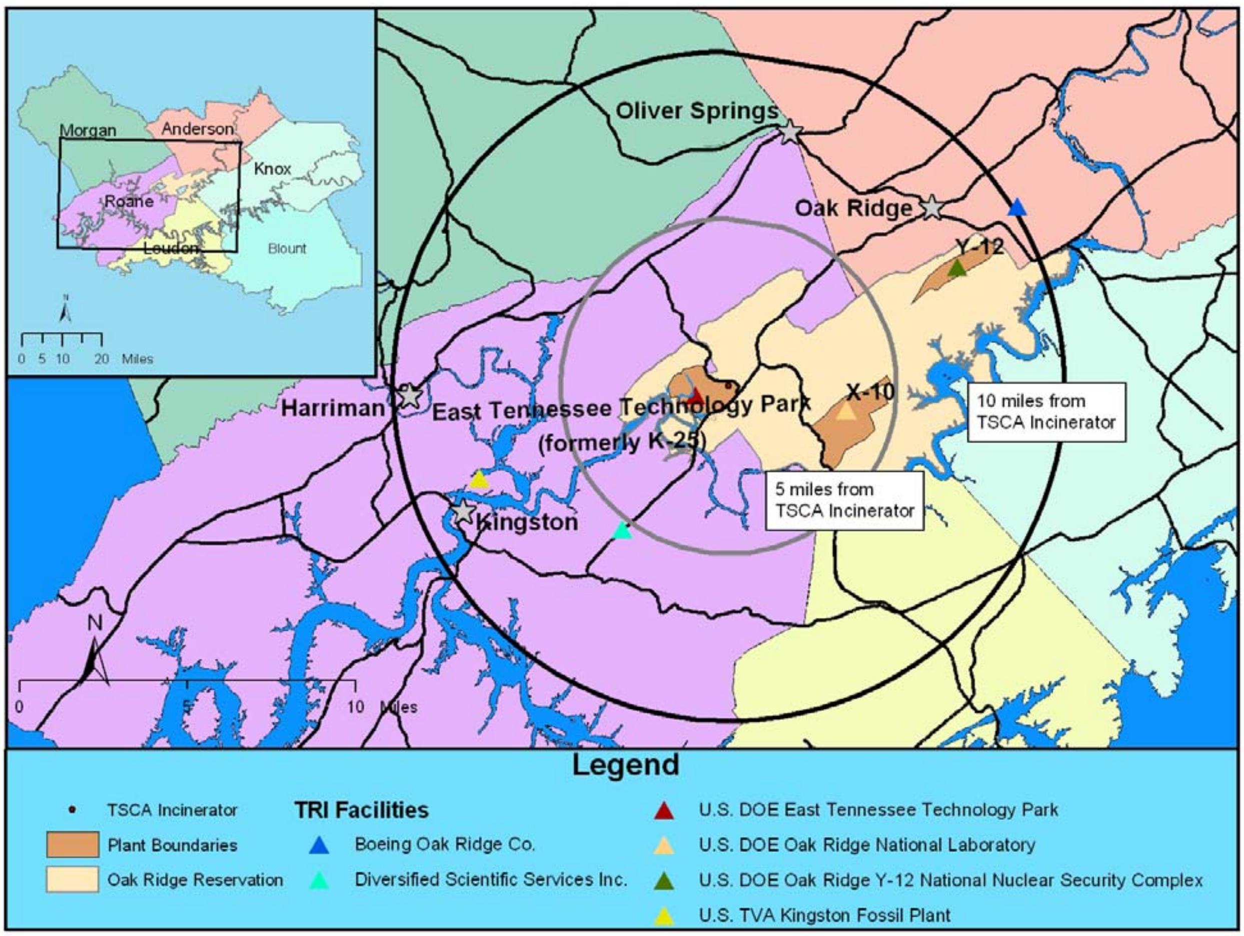
ATSDR is aware that community members have expressed concerns about other air emissions sources more than 10 miles from the TSCA Incinerator. For instance, community members have asked about the significance of TVA's Bull Run Steam Plant, which is located northeast of ORR, about 13 miles from the TSCA Incinerator. In Section V.B of this PHA, ATSDR provides some context on that facility's emissions.

Table 4. Air Toxics Emissions Data from EPA's 2001 Toxic Release Inventory (TRI) for Industrial Facilities within Approximately 10 Miles of ETTP (see notes on following page)

Facility Name	***Approximate Distance from ETTP (See Figure 7)***	***Total Air Emissions of Toxic Contaminants Disclosed to TRI in Reporting Year 2001***
U.S. DOE East Tennessee Technology Park	0 miles	Hydrochloric acid = 25 lbs.
		Lead = 58 lbs.
U.S. DOE Oak Ridge Natl. Lab.	4 miles	Lead = 1 lbs.
Diversified Scientific Services, Inc. (DSSI)	5 miles	Acetonitrile = 14 lbs.
		Methylene chloride = 11 lbs.
		Methanol = 22 lbs.
		n-Hexane = 15 lbs.
		Toluene = 20 lbs.
		Xylenes = 21 lbs.
U.S. TVA Kingston Fossil Plant	8 miles	1,2,4-Trimethylbenzene = 500 lbs.
		Arsenic compounds = 1,505 lbs.
		Barium compounds = 1,250 lbs.
		Chromium compounds = 755 lbs.
		Cobalt compounds = 255 lbs.
		Copper compounds = 755 lbs.
		Hydrochloric acid = 4,000,005 lbs.
		Hydrogen fluoride = 510,005 lbs.
		Lead compounds = 242 lbs.
		Manganese compounds = 1,000 lbs.
		Mercury compounds = 450 lbs.
		n-Hexane = 500 lbs.
		Nickel compounds = 255 lbs.
		Polycyclic aromatic cmpds. = 27 lbs.
		Selenium compounds = 7,705 lbs.
		Sulfuric acid = 1,400,005 lbs.
		Vanadium compounds = 755 lbs.
		Zinc compounds = 255 lbs.
U.S. DOE Oak Ridge Y-12 National Security Complex	8 miles	Freon 113 = 16,530 lbs.
		Hydrochloric acid = 102,332 lbs.
		Lead compounds = 4 lbs.
		Mercury compounds = 2 lbs.
		Methanol = 21,417 lbs.
		Nitric acid = 2,601 lbs.
		Sulfuric acid = 44,221 lbs
Boeing Oak Ridge Co.	10 miles	Nitric acid = 143 lbs.

Notes on Table 4:
Source of data: EPA 2004a.
Air emissions for ETTP should include amounts of chemicals released from the TSCA Incinerator that are subject to the TRI reporting requirements. The 2001 TRI data for ETTP include forms for PCBs and hexachlorobenzene. However, both forms reported zero air emissions and are therefore not included in the table above.
Data are presented for calendar year 2001. These were the most recent TRI data available when this PHA was first drafted.
The TRI regulations require facilities in certain industries to disclose the amounts of specific toxic chemicals that are released to the environment or managed as waste. However, the regulations do not require that all facilities report, and they do not apply to all toxic chemicals. As a result, this table should not be viewed as a comprehensive inventory of industrial air emissions for the Oak Ridge area. Further, the data in this table likely do not represent all toxic air emissions for the facilities listed. TRI data are self-reported; the accuracy of the release data and the geographic coordinates for individual facilities is not known.

Figure 7. Facilities within 10 Miles of ETTP that Disclosed Air Emissions to EPA's Toxics Release Inventory in Reporting Year 2001



Notes:
Source of data: EPA 2004.
Only facilities that reported air releases to TRI were considered for this figure.
The TRI regulations require facilities in certain industries to disclose the amount of specific toxic chemicals they release to the environment or manage as waste. Still, the regulations do not require that all facilities report, and do not address all contaminants; this is presumably why this figure does not identify every industrial facility in the Oak Ridge area. Therefore, this figure does not present a comprehensive account of industrial air emissions sources near ETTP. TRI data are self-reported; the accuracy of the release data and the geographic coordinates for individual facilities is not known.

- **Other emissions sources.** Recognizing that TRI data characterize air emissions from only industrial emissions sources, ATSDR accessed additional data from EPA's National Emissions Inventory (NEI) — an emissions inventory that accounts for releases from industrial sources, mobile sources, agricultural sources, natural sources, and other types of releases. Table 5 summarizes the most recent NEI data for Roane County for selected criteria pollutants, which are pollutants commonly associated with general air quality concerns. Table 5 clearly indicates that air emissions from ETTP, which include emissions from the TSCA Incinerator, account for an extremely small portion (less than 0.2%) of the county's air emissions of carbon monoxide, nitrogen oxides, particulate matter smaller than 10 microns (PM10), sulfur dioxide, and volatile organic compounds (VOCs). As Section II.E.2 describes further, the data in Table 5 provide important context for two general air quality concerns for the Knoxville metropolitan area.

Overall, the previous discussion reveals that the TSCA Incinerator not only is a relatively isolated source of air emissions, but also appears to account for a small fraction of the total air emissions throughout Roane County and the Oak Ridge area. Consequently, the levels of air pollution measured in the area generally cannot be assumed to result entirely from the TSCA Incinerator. Nevertheless, this PHA thoroughly evaluates the public health implications of all emissions and ambient air sampling data collected for this site, including contaminants (e.g., radionuclides) not typically reported in TRI, NEI, and other emission inventories.

II.E.2. General Air Quality in the Knoxville Metropolitan Area

For more than 20 years, EPA and state environmental agencies have evaluated general air quality concerns by measuring ambient air concentrations of six common air pollutants, also known as criteria pollutants. The criteria pollutants are

- carbon monoxide,
- lead,
- nitrogen dioxide,
- ozone,
- two forms of particulate matter, and
- sulfur dioxide.

Many different air emissions sources contribute to the airborne levels of these pollutants. For every criteria pollutant EPA has established a health-based National Ambient Air Quality Standard (NAAQS). In cases where air quality does not meet an NAAQS, states are required to develop and implement plans to bring air pollution levels into attainment with the health-based standards. The following paragraphs review the general air quality in the Knoxville metropolitan area:[1]

1 For the purposes of this PHA, ATSDR considered the following counties to be part of the Knoxville metropolitan area: Anderson County, Blount County, Jefferson County, Knox County, Loudon County, Roane County, Sevier County, and Union County. This list of counties is based primarily on counties that EPA considered when evaluating the attainment status for 8-hour average ozone concentrations (EPA 2004f) and PM2.5 concentrations (EPA 2004c).

Table 5. EPA's 1999 National Emissions Inventory (NEI) Data for Roane County

Source Category	*Emissions Data for Selected Pollutants*									
	Carbon Monoxide		*Nitrogen Oxides*		*PM10*		*Sulfur Dioxide*		*VOCs*	
	Tons per Year	*% of Total*	*Tons per Year*	*% of Total*	*Tons per Year*	*% of Total*	*Tons per Year*	*% of Total*	*Tons per Year*	*% of Total*
ETTP (includes TSCA Incinerator)	5	<0.1%	30	0.1%	5	<0.1%	1	<0.1%	7	0.2%
Other major industrial sources	1,357	5.1%	26,782	86.8%	5,529	73.0%	110,795	99.6%	267	6.1%
Mobile sources	23,879	88.9%	3,898	12.6%	156	2.1%	221	0.2%	2,350	53.6%
All other sources	1,611	6.0%	153	0.5%	1,883	24.9%	169	0.2%	1,764	40.1%
Totals for Roane County	26,852	100%	30,863	100%	7,573	100%	111,186	100%	4,388	100%

Notes:
Source of data: EPA 2004b.
EPA updates its NEI data every 3 years. Results for 1999 are shown, as that is the most recent year for which final NEI data are available.
Air emissions for ETTP should include releases from the TSCA Incinerator.
The PM10 emissions data shown here include the sum of filterable and condensable particulate matter smaller than 10 microns.
"Other major industrial sources" is the sum of releases EPA has reported for the "major" air emissions sources in Roane County. A "major" source emits a threshold amount (or more) of at least one criteria pollutant; thus, this category includes the largest industrial emissions sources in the county. These include Oak Ridge National Laboratory, U.S. TVA Kingston Fossil Plant, Clinch River Corporation, Horsehead Resource Development Company, and Fortafil Fibers, Inc.
"Mobile sources" include a wide range of on-road and off-road mobile sources that burn gasoline, diesel fuel, and other types of fuels. These emissions sources include automobiles, trucks, and various commercial, industrial, recreational, and agricultural vehicles.
"All other sources" include industrial sources that are not categorized as major sources, residential emissions sources (e.g., fireplaces, wood-burning stoves, trash burning), and miscellaneous other sources (e.g., wind-blown dust, forest fires, structural fires).

- **Ozone.** Currently, at least eight ambient air monitoring stations throughout the Knoxville metropolitan area measure airborne levels of ozone throughout the summer months. In recent years, ozone levels at several stations exceeded EPA's health-based standards, suggesting that the air quality is at times unhealthy. As a result, the Knoxville metropolitan area is classified as a "non-attainment area" for ozone, and TDEC was required to develop a plan to improve the air quality. Refer to Section V of this PHA for more information on the health implications of exposure to elevated ozone levels.

> **What is ozone?** Ozone forms in air when emissions from numerous sources, including motor vehicles and industry, mix together and react with sunlight. Ozone levels are typically highest during the afternoon hours of the summer months, when the influence of direct sunlight is greatest. When airborne ozone levels are high enough, people may experience respiratory health problems.

The ozone air quality issue in the Knoxville metropolitan area is not unique. In fact, nearly every major metropolitan area along the East Coast has unhealthy ozone levels occasionally during the summer months. Moreover, more than 150 million residents nationwide live in ozone non-attainment areas. It is also important to note that the ozone problems in the Knoxville area are complex and result from industrial and motor vehicle emissions over a broad geographic region. Sources that release nitrogen oxides and VOCs (both known as ozone precursors) contribute significantly to ozone formation. As Table 5 shows, the TSCA Incinerator releases relatively small amounts of these precursors, especially when compared to other sources in Roane County and beyond. In short, the Knoxville area's ozone air quality issue is regional in nature and is largely unrelated to air emissions from the TSCA Incinerator. Consequently, this PHA addresses ozone issues in response to community concerns about general air quality (see Section V), and not as a site-specific issue.

Particulate matter. TDEC and other parties monitor airborne levels of particulate matter (PM) at several locations throughout the Knoxville metropolitan area. Monitoring currently occurs for three different size fractions of PM. While the monitoring data found airborne levels of larger particles (PM10 and TSP) to be safely below EPA's corresponding health-based standards, airborne levels of fine particulates (PM2.5) in Knox County are not. Therefore, Knox County has been designated a non-attainment area for PM2.5. EPA and TDEC are currently deciding which neighboring counties, if any, should be included in this non-attainment area (TDEC 2004; EPA 2004c).

> **What is particulate matter (PM)?** PM is airborne particles and droplets of varying sizes and chemical composition. Many different industrial, mobile, natural, agricultural, and other sources release PM directly to the air or release pollutants that form PM while in the air. Environmental regulations have addressed total suspended particulates (TSP), particulate matter smaller than 10 microns (PM10), and particulate matter smaller than 2.5 microns (PM2.5). Section III.D comments further on the different size fractions of PM.

Like the area's ozone problems, the PM2.5 issues in the Knoxville metropolitan area are not unique. According to EPA's most recent estimates, approximately 99 million U.S. residents — mostly in urban areas in the Midwest, northeast, and along the Appalachian Mountains —

live in PM2.5 “non-attainment areas.” In many cases, the PM2.5 problems cannot be attributed to a single source; PM2.5 forms in the air from many precursors that originate from multiple combustion and industrial sources over broad areas. That said, however, emission inventory data (e.g., Table 5) have shown that the TSCA Incinerator emits insignificant amounts of PM2.5 precursors, particularly when compared to other emissions sources in the Knoxville metropolitan area. Therefore, this PHA addresses the elevated PM2.5 levels in the Knoxville metropolitan area as a regional air quality issue (see Section V), not one resulting from the TSCA Incinerator’s emissions.

Airborne levels of ozone and PM2.5 are sometimes unhealthy in the Knoxville metropolitan area. The air quality problems for both pollutants are ***regional issues***—not directly the result of air emissions from the TSCA Incinerator. Section V of this PHA discusses the public health implications of living in areas where airborne ozone and PM2.5 levels are occasionally elevated.

- **Other pollutants.** The Knoxville metropolitan area is considered to be in attainment with the NAAQS for the remaining criteria pollutants: carbon monoxide, lead, nitrogen oxide, and sulfur dioxide. This means that ambient air concentrations of these pollutants are believed to be safely below EPA’s corresponding health-based air quality standards. As a result, this PHA does not discuss these pollutants any further.

II.F. Demographics

ATSDR examines demographic data to determine the number of people who are potentially exposed to environmental contaminants and to consider the presence of sensitive populations, such as children (age 6 years and younger), women of childbearing age (between ages 15 and 44 years), and the elderly (age 65 years and older). This section considers general population trends for residents nearest to the TSCA Incinerator and also identifies the residential areas closest to the site.

- **General population trends.** Figure 8 summarizes demographic data for areas within 3 miles of the TSCA Incinerator, based on information compiled in the 2000 U.S. Census. As the figure shows, most areas within 3 miles of the TSCA Incinerator are also within the ORR property boundary, where no one lives. Overall, an estimated 1,224 persons live within 3 miles of the site, and many of these individuals are life-long residents. These individuals live primarily northwest of the site (e.g., in the communities of Dyllis and Sugar Grove) and southwest of the site. The nearest school is approximately 3 miles from the TSCA Incinerator (IT Corporation 2000). According to the Census data, 8% of the population within 3 miles of the incinerator are children, and 11% are considered elderly.

- **Residents closest to the site.** The two residential areas nearest to the TSCA Incinerator are both more than 1 mile from the site. First, several homes and farms, mostly isolated, are located northwest of the incinerator along Blair Road, Sugar Grove Valley Road, Poplar Creek Valley Road, and other streets. The home in this area nearest to ETTP is approximately 1.7 miles from the TSCA Incinerator. Black Oak Ridge, however, separates this entire residential area from the site. This ridge likely limits (but does not prevent) the incinerator's emissions from blowing directly into the residential neighborhoods. Second, additional homes and farms are located southwest of, and across the Clinch River from, the TSCA Incinerator. These homes and farms are along Gallaher Road, Lawnville Road, and side streets of these roads. All residences in this area are at least 2.0 miles from the TSCA Incinerator, but in this case a large ridge does not separate this area from the site.

In addition to the aforementioned residential neighborhoods, where prolonged or chronic exposures to site contaminants are feasible, ATSDR also considered short-term exposures residents might experience when they are closer to the TSCA Incinerator. The nearest publicly accessible area is Blair Road, which at its closest point passes about ¼ mile from the base of the TSCA Incinerator stack. Residents are not expected to spend extended periods of time outdoors on the parts of Blair Road nearest to the TSCA Incinerator, though such activity is not prohibited.

Later sections of this PHA refer to the demographic data. Specifically, Section IV evaluates public health implications of chronic exposure for residential populations, and Section V presents health-related information specific to children and the elderly, which are known to be sensitive to exposures to certain air pollutants.

II.G. Summary of Public Health Activities Pertaining to the TSCA Incinerator

For more than 12 years, ATSDR has been evaluating environmental health issues related to other facilities at ORR. The text box at the end of this section describes how residents can get more information on ATSDR's past and ongoing environmental health activities for those other facilities. A timeline for the main public health activities specific to the TSCA Incinerator follows:

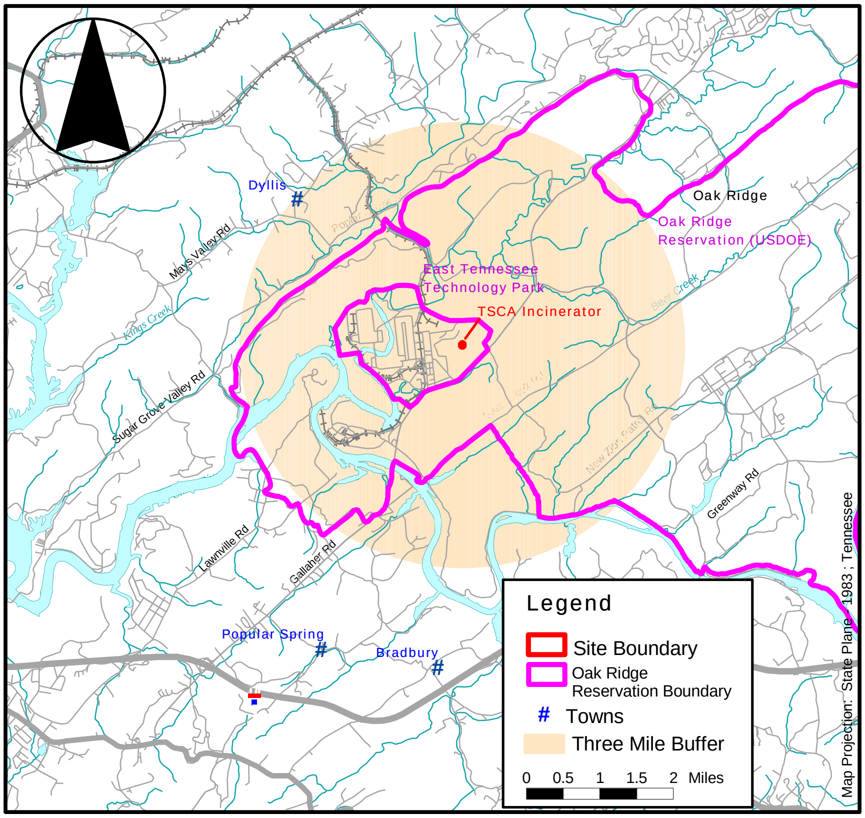
- In May 1997, amid growing community concerns regarding the TSCA Incinerator, the Governor of Tennessee convened an independent panel of environmental scientists, occupational health professionals, and engineers to evaluate DOE's operation of the site. The panel was charged with reviewing the operations and making recommendations to ensure that releases from the incinerator do not harm human health or the environment. The independent panel issued its final report on the TSCA Incinerator in January 1998 (Iglar et al. 1998). The report acknowledges that some workers and community members are sick from undetermined causes, but notes that the incinerator's emissions and local air quality measurements were generally within permissible values.

- In June 1997, TDEC prepared a report to respond to community concerns regarding the TSCA Incinerator (TDEC 1997). The report is titled *Responses to the 101 Questions from Citizens Presented to the Tennessee Department of Environment and Conservation*. While this report does not focus exclusively on public health activities, it addresses a wide range of community concerns related to the operation and oversight of the TSCA Incinerator.

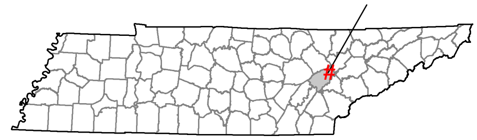
TSCA Incinerator

INTRO MAP

Oak Ridge, Tennessee



Base Map Source: 1995 TIGER/Line Files



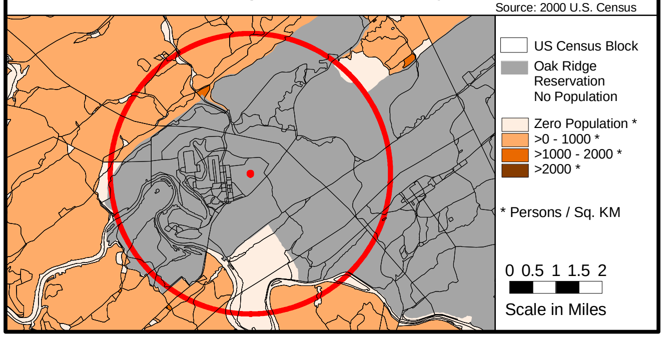
Roane County, Tennessee

Demographic Statistics Within Three Miles of Site*	
Total Population	1224
White alone	1181
Black alone	14
Am. Indian and Alaska Native alone	3
Asian alone	13
Native Hawaiian and Other Pacific Islander alone	0
Some other race alone	0
Two or More races	13
Hispanic or Latino	12
Children Aged 6 and Younger	96
Adults Aged 65 and Older	138
Females Aged 15 - 44	229
Total Housing Units	489

Demographics statistics Source: 2000 U.S. Census
*Calculated using an area-proportion spatial analysis technique

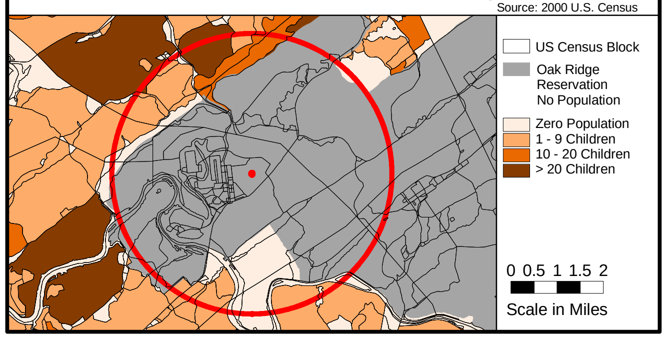
Population Density

Source: 2000 U.S. Census



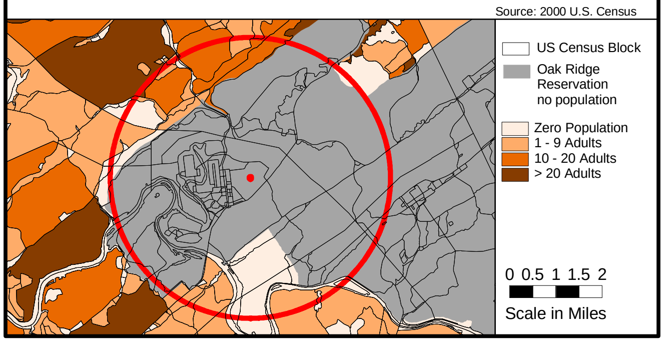
Children 6 Years and Younger

Source: 2000 U.S. Census



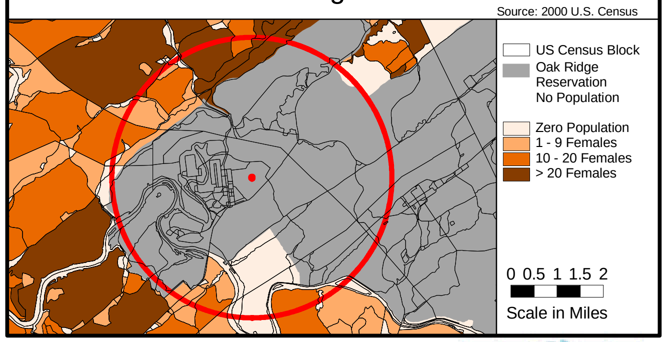
Adults 65 Years and Older

Source: 2000 U.S. Census



Females Aged 15 - 44

Source: 2000 U.S. Census



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Where can one obtain more information on ATSDR's activities at Oak Ridge?

In addition to completing this PHA, ATSDR and other agencies have evaluated numerous other environmental health issues related to ORR facilities. Community members can find more information on ATSDR's past activities by:

Visiting one of the records repositories. Copies of ATSDR's publications for ORR, along with publications from other agencies, can be viewed in records repositories at the DOE Information Center, the Harriman Public Library, the Kinsgton Public Library, the Oak Ridge Public Library, the Roane State Community College, and the Rockwood Public Library.

Visiting the ORRHES or ATSDR Web sites. These Web sites have links to past publications, schedules of future events, and related informational materials. The ORRHES site is http://www.atsdr.cdc.gov/HAC/oakridge and the ATSDR site is http://www.atsdr.cdc.gov. The most comprehensive summary of past activities is available online at http://www.atsdr.cdc.gov/HAC/oakridge/phact/c_toc.html.

Contacting ATSDR directly. Residents can contact representatives from ATSDR directly by dialing the agency's toll-free number, 1-888-42ATSDR (or 1-888-422-8737).

- In August 2003, ATSDR began the public health assessment process for the TSCA Incinerator. In the months that followed, ATSDR obtained and reviewed site documents prepared by numerous parties, including DOE and its contractors, EPA, TDEC, and local community groups. ATSDR contacted these and other parties (e.g., TVA) for access to relevant environmental sampling data.
- After thoroughly evaluating the information gathered to date, ATSDR presented its technical approach for the TSCA Incinerator PHA to community members at the Public Health Assessment Work Group (PHAWG) meeting held on March 15, 2004, in Oak Ridge, Tennessee. During this meeting community members asked ATSDR to address several health concerns specific to the TSCA Incinerator. ATSDR's responses to these concerns are included in Section V of this report.
- In March 2004, a team of ATSDR scientists and contractors, including air quality specialists, conducted a tour of the ETTP site. During the tour, ATSDR viewed the entire TSCA Incinerator process, reviewed selected records and reports maintained at the TSCA Incinerator, viewed meteorological and ambient air monitoring equipment at several locations, and drove around the perimeter of ETTP and through surrounding residential neighborhoods.
- On November 15, 2004, ATSDR presented its preliminary findings on the TSCA Incinerator PHA to community members at the newly formed Exposure Evaluation Work Group meeting. During this meeting, community members identified a few health concerns that had

not been communicated to the agency previously. ATSDR's responses to these concerns are included in Section V of this report.

- On March 22, 2005, ATSDR presented the main findings of the Public Comment Release PHA to the Oak Ridge Reservation Health Effects Subcommittee (ORRHES).
- On September 22, 2005, ATSDR gave a presentation before ORRHES to summarize comments received from the public and peer reviewers on the Public Comment Release PHA.

II.H. Quality Assurance and Quality Control

To prepare this PHA, ATSDR reviewed and evaluated information provided in the documents listed in the References (see Section XII). The environmental data presented in this PHA are from reports produced by many parties, including DOE, EPA, TDEC, and TVA. The limitations of these data have been identified in the associated reports, and, where appropriate, they are restated in this document. After reviewing the studies conducted to date, ATSDR determined that the quality of environmental data available in the site-related documents for the TSCA Incinerator is adequate to support public health decisions. ATSDR has made specific recommendations to improve, or better characterize, the quality of certain environmental sampling efforts. Refer to Appendix C for ATSDR's specific conclusions regarding the quality of the ambient air monitoring and ambient air sampling studies.

ATSDR also used an extensive review process for quality control purposes. Earlier drafts of this PHA and draft findings were presented to numerous parties, including ATSDR scientists with extensive experience in incineration and radiation exposure assessment, DOE, EPA, TDEC, ORRHES, and the PHAWG. ATSDR hopes that this extensive review process has helped ensure that all information and scientific analyses presented in this PHA are scientifically sound and technically accurate.